E-BUSINESS SUITE APPLICATIONS R12 (12.1.3) EXTRA-LARGE PAYROLL (BATCH) BENCHMARK - USING ORACLE11g ON ORACLE'S SPARC T7-1 SERVER

As a global leader in e-business applications, Oracle is committed to delivering high performance solutions that meet our customers' expectations. Business software must deliver rich functionality with robust performance. This performance must be maintained at volumes that are representative of customer environments.

Oracle benchmarks demonstrate our software's performance characteristics for a range of processing volumes in a specific configuration. Customers and prospects can use this information to determine the software, hardware, and network configurations necessary to support their processing volumes.

The primary objective of our benchmarking effort is to provide as many data points as possible to support this important decision.

SUMMARY OF RESULTS

This batch benchmark test was run on a 32-core server.

Batch Workload			
250,000 Employees	**Threads**	**Time (Min)**	**Hourly Employee Throughput**
Payroll Processing	112	1.57	9,554,140
PrePayments	48	0.73	20,547,945
External Archive	224	6.55	2,290,076
NACHA	8	0.15	100,000,000
Checkwriter	4	0.17	88,235,294
Costing	32	0.65	23,076,923
Totals:		9.82	1,527,494
Parent Proc. Total		20.17	743,678
Wall Clock Duration*		20.17	743,678

Note that the hourly throughput numbers mentioned above are linear extrapolations. Many factors can influence performance and your results may differ.

* The "Wall Clock Duration" includes all of the job scheduling and management activity (parent process) as well as some idle intervals due to polling or waiting for all workers in a particular process to complete prior to kicking off the subsequent process. These intervals would not increase substantially, if at all, as the workload size is increased. Consequently, the throughput for larger workloads would converge toward the "Totals:" value.

BENCHMARK PROFILE

In October 2015, Oracle conducted a benchmark in Burlington, MA to measure the batch performance of the Oracle E-Business Standard Benchmark processes in an environment running Oracle E-Business Suite R12 (12.1.3) with Oracle11g™ database (11.2.0.3.0) for the Solaris® operating system on an Oracle's SPARC T7-1 server configured with one thirty-two core processor (32-cores total), running Oracle® Solaris® 11 (64-bit) OS. A single Oracle ZFS Storage ZS3-2 Appliance was used for data and one Oracle Flash Accelerator F160 PCIe Card 1.6TB NVMe was used for logging.

The benchmark measured the Payroll batch business process hourly throughputs for an extra-large database model. Testing was conducted in a controlled environment with no other applications running. **The goal of this Benchmark was to obtain reference batch throughputs for Oracle E-Business Suite R12 Benchmark on an Oracle's SPARC T7-1 server running Solaris 11.**
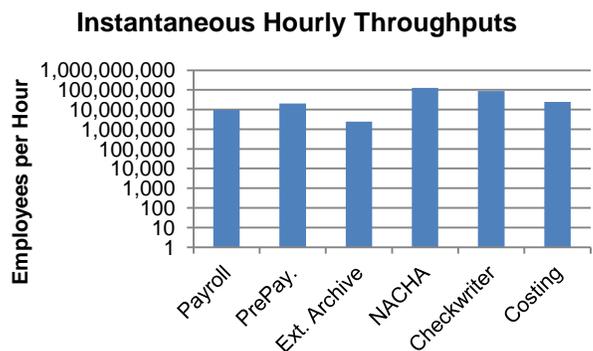

Figure 1: Oracle E-Business Payroll Batch Throughputs

BENCHMARK METHODOLOGY

E-Business Suite R12 Benchmark batch processes are initiated from a benchmark-provided SQL script.

The batch workloads were run as standard concurrent processes via the concurrent manager.

Figure 2 shows the configuration used for this benchmark run.

	SPARC T7-1 DB Server/ App Server 32-core 256 GB Memory 28% Utilized
	Oracle ZFS Storage ZS3-2 Appliance 40 × 900 GB SAS-2 HDD + 8 Write Flash Accelerator SSD + 2 Read Flash Accelerator SSD 1.6 TB SAS (Data, Log, Cache) [Not Shown] Oracle Flash Accelerator F160 PCIe Card 1.6 TB NVMe (Logs)

Figure 2: 2-Tier Configuration

This benchmark was run as a "Physical" 2-Tier configuration with a single machine hosting both the Database and Application server instances on a single OS image.

BENCHMARK BUSINESS PROCESSES

This E-Business Suite benchmark consists of a batch flow with six metered processes.

Batch Payroll Processes

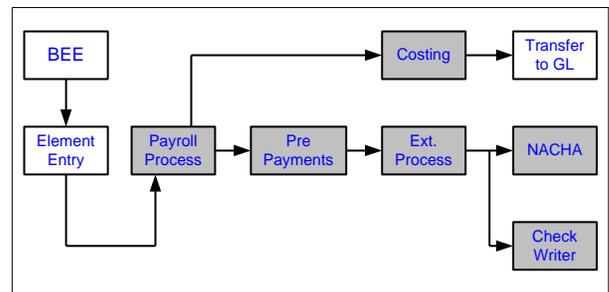| Business Process	Number of Threads Used	Process Type
Payroll Process	112	Pro-C
PrePayments	48	Pro-C
External Archive Process	224	Pro-C & PL/SQL
NACHA	8	Pro-C
Check Writer	4	Pro-C & Oracle Report Writer
Costing	32	Pro-C

Figure 3: Payroll Process Flow

The Oracle E-Business Suite R12 Payroll processes tested are as follows:

Payroll Process: Identifies all employees to be processed and performs calculations required to complete the gross-to-net calculation, including earnings, deductions, and taxes. The specific groups of employees processed can be controlled by multiple parameters to the payroll process, including the ability for a user to define a rules-based set of employees.

PrePayments: Distributes the net pay for each employee across the various payment methods (Direct Deposit, Check, or Cash). This can be run for a single payroll process or across multiple payroll processes.

External Archiving Process: (Pro-C, PL/SQL) Replicates the results of the Payroll run into a separate archive for audit purposes. This data is primarily used for Payslips (Both printed and on line), as a source for check and direct deposit printing, third party interfaces, and tax remittance reporting.

NACHA: This is the US version of the Global Direct Deposit process, which creates the bank interface file as per NACHA rules, based on the rules in the Pre Payment process.

Check Writer: (Oracle Report Writer) This process allocates check numbers and creates/prints the payroll check and associated paper payslip.

Costing: This process associates the payroll transaction data with the General Ledger (GL) accounts in preparation for transfer of the data to GL. This process uses a sophisticated hierarchical rules-based engine to determine the mapping of the HRMS data and payroll results to the GL accounts.

BENCHMARK RESULTS

Batch Business Metrics		Achieved Output
Payroll		
Payroll Process		500,000
PrePayment		250,000
NACHA + Check		250,000
Costing		250,000

Table 1: Batch Transactions Completed

In this test, 250,000 employees were processed. One checkpoint was completed during the measurement interval. Table 2 shows the processing time in minutes.

Batch Workload			
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Wall Clock Duration*		20.17	743,678

Table 2: Payroll Batch Performance

R12 Application changes, data model additions and test methodology improvements render direct comparison to previous Oracle E-Business release 11.5.10 and 11.5.9 results invalid.

SERVER PERFORMANCE

Figure 4 shows the average CPU utilization on the Database server. The value shown is the average across the processors (32 cores total).
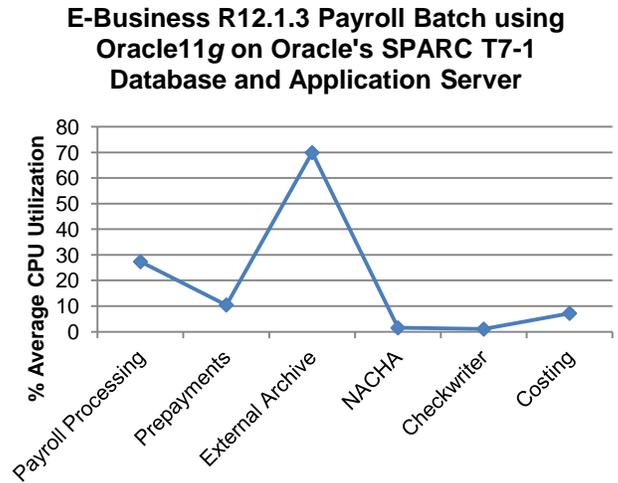

Figure 4: Average DB/App CPU Utilization

Note that the high processing power applied to the briefest business processes resulted in sparse CPU data sampling.
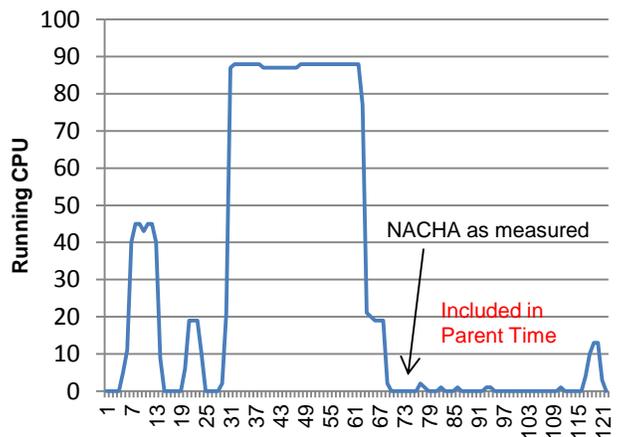

Figure 5: Running CPU Utilization

Figure 5 shows the CPU activity for the entire sequence of processes. Processing after the reported NACHA 'child' threads appears to account for much of the discrepancy between the overall sum of the 'child' threads and the overall sum of the 'parent' threads.

SERVER PERFORMANCE CONTINUED

Online Workload	% User	% System	% Idle
Payroll Processing	24.75	2.5	72.67
PrePayments	9.86	0.57	89.57
External Archive	69.19	0.63	30.09
NACHA	1.5	0	98.5
Checkwriter	1	0	99
Costing	5.67	1.17	92.83
Wall Clock Avg.	27.47	0.55	71.89

Table 3: Average Server CPU Utilization

Average GB Used	DB Server
224-Threads	97.77 GB

Table 5: Average Memory Utilization

I/O PERFORMANCE

An Oracle ZFS Storage ZS3-2 Appliance equipped with 2 Storage Drive Enclosures (40 HDD + 8 Log SSD + 2 Cache SSD) was used for storage. The batch workload requires optimal I/O performance.

I/O Performance		Data	Log
Transfers/Sec	Avg	369	
	Peak	1,973	
Writes/Sec	Avg	313	531
	Peak	1,800	5,181
Reads/Sec	Avg	56	
	Peak	1,144	
MB/Sec	Avg	20	
	Peak	97	
Write MB/Sec	Avg	19	19
	Peak	96	120
Read MB/Sec	Avg	0.5	
	Peak	9.0	
Service Time (ms)	Avg	2.15	0.16
	Peak	5.60	0.50

Table 6: Average I/O Utilization Breakout

DATA COMPOSITION DESCRIPTION

Major data components for the model under test are summarized in the following table.

Application	Business Objects	Large/Extra-Large Model
HR	Employees	250,000

Table 7: Data Composition

PATCHES

The following patches were applied to the benchmark environment on top of Oracle E-Business Suite R12 (12.1.3).

1. 9858539: DATA PUMP IMPORT FAILS for LOGON TRIGGER ORA-04072: INVALID TRIGGER TYPE

2. 12942119: APPSPERF: CBO using EMPTY INDEX STATS VS DYNAMIC SAMPLING for TAB W/NO STATS

3. 12960302: TST&PERF: QUERY REPORT CORRUPT METADATA of CONTEXT INDEX after database upgrade

4. 4247037:   Unique Patch ID: 14211388

5. 12985184:   Unique Patch ID: 14321186

6. 13001379:   Unique Patch ID: 14706905.1

7. 13004894:   Unique Patch ID: 14182829

8. 13258936:   Unique Patch ID: 14465000

9. 13366268:   Unique Patch ID: 14394336

APPLICATION PATCHES CONTINUED:

1) Patch 8300196 applied on Thu Mar 26 06:05:24 GMT-05:00 2009
   [Base Bug(s): 8300196]

2) Patch 5651245 applied on Thu Mar 26 06:04:56 GMT-05:00 2009
   [Base Bug(s): 5651245]

3) Patch 7329300 applied on Thu Mar 26 06:04:22 GMT-05:00 2009
   [Base Bug(s): 7329300]

4) Patch 7580744 applied on Thu Mar 26 06:03:15 GMT-05:00 2009
   [Base Bug(s): 7580744]

5) Patch 7379122 applied on Thu Mar 26 06:02:36 GMT-05:00 2009
   [Base Bug(s): 5179574 5637094 5239126 5095815 5055442 4554284 5029950 4587572 4903532 4439469 4197970 4601861 7044603 4900129 5960451 6607951 5225797 5401921 5049074 6826532 5354517 4905112 4873311 5406923 5631915 5114396 5644862 7300525 5861360 5095648 4610820 5092688 6455161 6705965 4335559 4671216 4492467 6397568 5029952 5029954 3962946 4329444 4542188 4899479 4458415 4712638 5276400 7022400 5222032 6009358 7334756 5258410 5065930 4555795 5094098 5490935 6737308 6055387 5233111 4359124 6350565 4175906 4871035 4587431 4486132 4348230 4661844 5584790 6639839 4152843 4597251 5242647 5650178 4402808 4768040 4561867 5738539 5933477 5091108 4691191 5376215 5015557 7379122 7135493 4605877 5605370 5689908 5675556 4969005 4745776 5243019 5227879 5408664 4969029 7120513 7137797 5049077 4146291 4679094 4166537 3743912 4047969 4925103 6999528 5490845 4593539 5648102 5151518 5464895 4754900 5751672 5458543 5071931 4751932 5998987 5222931 5648727 5057964 6270140 4519477 4939157 6404447 5226235 5884075 4680009 6130365 7135488 5910829 3345756 5896963 6016022 5382595 4966417 6753516 4226736 5347751 5014128 5501362]

6) Patch 7121788 applied on Thu Mar 26 06:01:42 GMT-05:00 2009
   [Base Bug(s): 7121788]

7) Patch 6400501 applied on Thu Mar 26 06:01:02 GMT-05:00 2009
   [Base Bug(s): 6400501]

8) Patch 5394728 applied on Thu Mar 26 06:00:02 GMT-05:00 2009
   [Base Bug(s): 5394728]

9) Patch 3559326 applied on Thu Mar 26 05:59:29 GMT-05:00 2009
   [Base Bug(s): 3559326]

10) Patch 7140405 applied on Thu Mar 26 05:59:00 GMT-05:00 2009
   [Base Bug(s): 6116405 6764875]

11) Patch 7281456 applied on Thu Mar 26 05:58:23 GMT-05:00 2009
   [Base Bug(s): 6371228]

12) Patch 7195389 applied on Thu Mar 26 05:57:53 GMT-05:00 2009
   [Base Bug(s): 5917053]

13) Patch 7016961 applied on Thu Mar 26 05:57:19 GMT-05:00 2009
   [Base Bug(s): 7016961]

14) Patch 4526825 applied on Thu Mar 26 05:56:38 GMT-05:00 2009
   [Base Bug(s): 4526825]

15) Patch 4407272 applied on Thu Mar 26 05:55:56 GMT-05:00 2009
   [Base Bug(s): 4407272]

16) Patch 6857221 applied on Thu Mar 26 05:55:15 GMT-05:00 2009
   [Base Bug(s): 6857221]

17) Patch 7229760 applied on Thu Mar 26 05:54:29 GMT-05:00 2009
   [Base Bug(s): 6823259 6790720 6251633 6999812 7150529 7000696 7114153 6770810 6446152 7229760 7242694 5465339 6724714 6821297 6395358 7046878 6704955 7021759]

APPLICATION TUNING

Database:

1. Gather stats as follows:

```
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ACTION_INFORMATION_N1',
estimate_percent => 100);
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ACTION_INFORMATION_N4',
estimate_percent => 100);
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ACTION_INFORMATION_N5',
estimate_percent => 100);
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ACTION_INFORMATION_PK',
estimate_percent => 100);
  dbms_stats.gather_table_stats(ownname => 'HR', tabname
=> 'PAY_ACTION_INFORMATION', estimate_percent =>
100, method_opt => 'FOR ALL COLUMNS SIZE AUTO');
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ACTION_INTERLOCKS_PK',
estimate_percent => 100);
  dbms_stats.gather_table_stats(ownname => 'HR', tabname
=> 'PAY_ACTION_INTERLOCKS', estimate_percent =>
100, method_opt => 'FOR ALL COLUMNS SIZE AUTO');
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ASSIGNMENT_ACTIONS_FK2',
estimate_percent => 100);
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ASSIGNMENT_ACTIONS_N2',
estimate_percent => 100);
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ASSIGNMENT_ACTIONS_N3',
estimate_percent => 100);
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ASSIGNMENT_ACTIONS_N4',
estimate_percent => 100);
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ASSIGNMENT_ACTIONS_N51',
estimate_percent => 100);
  dbms_stats.gather_index_stats(ownname => 'HR',
indname => 'PAY_ASSIGNMENT_ACTIONS_PK',
estimate_percent => 100);
  dbms_stats.gather_table_stats(ownname => 'HR', tabname
=> 'PAY_ASSIGNMENT_ACTIONS', estimate_percent =>
100, method_opt => 'FOR ALL COLUMNS SIZE AUTO');
  exec fnd_stats.gather_table_stats
('APPLSYS','FND_CURRENCIES',100,cascade=>TRUE);
  exec fnd_stats.gather_schema_stats (schemaname =>
'HR',estimate_percent => 100,degree => 8);
```

OPERATING SYSTEM TUNING

DATABASE OPERATING SYSTEM TUNING

set autoup=600

set tune_t_fsflushr=10

set tsb_rss_factor=128

BENCHMARK ENVIRONMENT

HARDWARE CONFIGURATION

A single Oracle's SPARC T7-1 server was used for the database server and middle-tier server. It was equipped with the following:

- 1 × SPARC M7 processor (4.13 GHz, 1-chip, 32-cores, 256-threads total), each with 64 MB of Level 3 cache (8 MB per 4-core cluster)

- 256 Gigabytes of Memory (~100 peak)

- 1 × Oracle ZFS Storage ZS3-2 Appliance (40 × 900 GB SAS-2 HDD and 8 × Write Flash Accelerator SSD [Log] and 2 × Read Flash Accelerator SSD 1.6 TB SAS [Cache]) for DB data

- 1 × Oracle Flash Accelerator F160 PCIe Card 1.6 TB NVMe for DB Redo Logs

SOFTWARE VERSIONS

Oracle E-Business Suite R12 (12.1.3)

Oracle11g™ 11.2.0.3.0 (64-bit)

Oracle Solaris 11 (64-bit) on the database/application server.

The following Java versions have all been used in the Oracle Apps environment:

- Java 1.4.1_04-b05
- Java 1.4.2_08-b03
- Java 1.4.2_10-b03
- Java 1.5.0_07-b03
- Java 1.5.0_08-b03
- Java 1.5.0_18-b02
- Java 1.5.0_30-b03
- Java 1.6.0_17-b04

Glossary and Acronyms:

OASB   Oracle Applications Standard Benchmark

RAC   **R**eal **A**pplications **C**lusters

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